

DIALOG(R)File 351:Derwent WPI  
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010486179 \*\*Image available\*\*

WPI Acc No: 1995-387559/199550

Related WPI Acc No: 1986-287334; 1994-113108

XRAM Acc No: C95-166789

XRPX Acc No: N95-283262

**In-line or flat lead type resin mould semiconductor device - has electrodes of IC or LSI chip joined to bump electrodes of lead frame substrate**

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Number of Countries: 001 Number of Patents: 002

Patent Family:

| Patent No  | Kind | Date     | Applicat No | Kind | Date     | Week     |
|------------|------|----------|-------------|------|----------|----------|
| JP 7263614 | A    | 19951013 | JP 93102900 | A    | 19850314 | 199550 B |
|            |      |          | JP 9557537  | A    | 19850314 |          |
| JP 2549277 | B2   | 19961030 | JP 93102900 | A    | 19850314 | 199648   |
|            |      |          | JP 9557537  | A    | 19850314 |          |

Priority Applications (No Type Date): JP 93102900 A 19850314; JP 9557537 A 19850314

Patent Details:

| Patent No  | Kind | Lan | Pg | Main IPC    | Filing Notes                     |
|------------|------|-----|----|-------------|----------------------------------|
| JP 7263614 | A    |     | 5  | H01L-023/50 | Div ex application JP 93102900   |
| JP 2549277 | B2   |     | 5  | H01L-023/50 | Div ex application JP 93102900   |
|            |      |     |    |             | Previous Publ. patent JP 7263614 |

Abstract (Basic): JP 7263614 A

The device comprises the electrodes of an IC or LSI chip connected respectively to the bump electrodes of a lead frame substrate, and has the S content of an Ni material forming each of the bump electrodes controlled at 0.04% or less.

ADVANTAGE - The chip and the substrate are reliably interconnected.

Dwg.3/7

Title Terms: LINE; FLAT; LEAD; TYPE; RESIN; MOULD; SEMICONDUCTOR; DEVICE; ELECTRODE; IC; LSI; CHIP; JOIN; BUMP; ELECTRODE; LEAD; FRAME; SUBSTRATE  
Derwent Class: A85; L03; U11

International Patent Class (Main): H01L-023/50

International Patent Class (Additional): C22C-019/03; H01L-021/321

File Segment: CPI; EPI

?

(19)日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11)特許出願公開番号

特開平7-263614

(43)公開日 平成7年(1995)10月13日

| (51)Int.Cl. <sup>6</sup> | 識別記号 | 庁内整理番号  | F I            | 技術表示箇所             |
|--------------------------|------|---------|----------------|--------------------|
| H 0 1 L 23/50            | V    |         |                |                    |
|                          | S    |         |                |                    |
| C 2 2 C 19/03            | M    |         |                |                    |
| H 0 1 L 21/321           |      | 9169-4M | H 0 1 L 21/ 92 | 6 0 3 B            |
|                          |      |         | 審査請求 有         | 発明の数 2 O L (全 5 頁) |

(21)出願番号 特願平7-57537  
(62)分割の表示 特願平5-102900の分割  
(22)出願日 昭和60年(1985)3月14日

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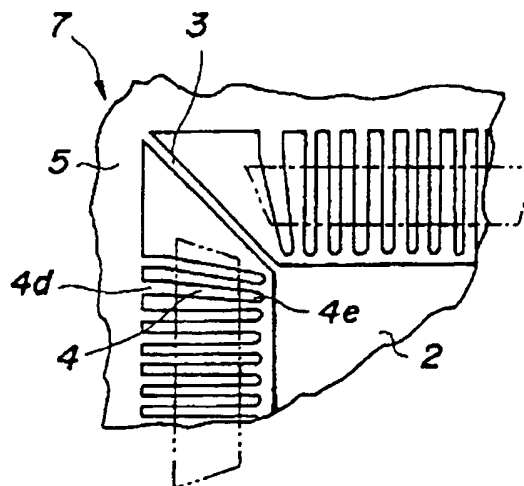
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(54)【発明の名称】 半導体装置

(57)【要約】

【目的】 リードフレームが十分な機械的強度を有し、しかも半導体チップの電極とリードフレームとの接合が確実な、信頼性の高い半導体装置を提供する。

【構成】 半導体チップ1の電極にリードフレーム7のバンプ4 fを接続してなる半導体装置において、前記バンプ4 fを形成するニッケル材のイオウ含有率が0.04%以下に規制されていることを特徴とする。



## 【特許請求の範囲】

【請求項1】 半導体チップの電極にリードフレームのバンパを接続してなる半導体装置において、前記バンパを形成するニッケル材のイオウ含有率が0.04%以下に規制されていることを特徴とする半導体装置。

【請求項2】 半導体チップの電極にリードフレームのバンパを接続してなる半導体装置において、前記バンパを形成するニッケル材がカーボンとイオウを含み、カーボンの含有率が0.01~0.04%の範囲に規制され、イオウの含有率が0.01~0.04%の範囲に規制され、かつカーボンとイオウの合計含有率が0.07%以下に規制されていることを特徴とする半導体装置。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】 本発明は、IC、LSI等の半導体チップを備えた半導体装置に係り、特にその半導体装置のリードフレームに関するものである。

## 【0002】

【従来の技術】 従来より半導体チップを樹脂モールドで一体化して複数のピンを突設した半導体装置の組立てには、金属製のリードフレームが用いられている。このリードフレームの形状は図7に示すように、半導体チップ1を取り付ける矩形のタブ2をその四隅において支持するタブリード3と、タブ2の周縁に内端を臨ませる多数のフィンガ4と、これらフィンガ4及びタブリード3の外端を支持する枠部5と、枠部5の両端縁に沿って定間隔に設けられたスプロケット孔6とから構成されている。

【0003】 このようなリードフレーム7を用いて半導体装置を組み立てるには、まずタブ2上に半導体チップ1を取り付け、半導体チップ1の各電極とこれに対応するフィンガ4の内端（先端部）を直接に接合し、枠部5の内側領域を合成樹脂でモールドし半導体チップ1を被覆して、次いで枠部5を切除することによりフラットリードあるいはインライン型の半導体装置を得ていた。

## 【0004】

【発明が解決しようとする課題】 ところで、従来の半導体装置ではリードフレームの機械的強度に問題があり、本発明者らはこの点について検討した結果、光沢剤の含有率が影響していることを見出した。すなわち、ニッケルの電鍍によってリードフレームを形成する場合、光沢剤としてカーボンならびにイオウが使用されるが、この光沢剤の含有率が通常0.1%程度である。このように光沢剤の含有率が高いと、半導体チップとの接合（半田付け）時にリードフレームの温度上昇により、ニッケルが脆化して機械的強度が低下する。また光沢剤を全く含有しなければ、最初から機械的強度が弱く、加工時の変形によって隣のリードフレームと接触して短絡する恐れ

がある。

【0005】 特に光沢剤中のイオウの含有率が高いと、前述の問題に加えて、リードフレームのニッケルと半田中のスズとが反応して、密着性の悪いNi-Sn合金層が形成され、リードフレームが半導体チップから剥離することがある。

【0006】 本発明の目的は、前述した従来技術の欠点を解消し、リードフレームが十分な機械的強度を有し、しかも半導体チップの電極とリードフレームとの接合が確実な、信頼性の高い半導体装置を提供することにある。

## 【0007】

【課題を解決するための手段】 前記目的を達成するため、第1の本発明は、半導体チップの電極にリードフレームのバンパを接続してなる半導体装置において、前記バンパを形成するニッケル材のイオウ含有率が0.04%以下に規制されていることを特徴とするものである。

【0008】 前記目的を達成するため、第2の本発明は、半導体チップの電極にリードフレームのバンパを接続してなる半導体装置において、前記バンパを形成するニッケル材がカーボンとイオウを含み、カーボンの含有率が0.01~0.04%の範囲に規制され、イオウの含有率が0.01~0.04%の範囲に規制され、かつカーボンとイオウの合計含有率が0.07%以下に規制されていることを特徴とするものである。

## 【0009】

【作用】 第1の発明のように、バンパを形成するニッケル材中のイオウの含有率を0.04%以下に規制することにより、Ni-Sn合金層の生成を抑制して、半導体チップとリードフレームとの接合を確実にすることができ

【0010】 第2の発明のように、バンパを形成するニッケル材中のカーボンの含有率を0.01~0.04%の範囲に、イオウの含有率を0.01~0.04%の範囲に、かつカーボンとイオウの合計含有率を0.07%以下に規制することにより、半導体チップとの接合時におけるリードフレームの熱的影響によるニッケルの脆化を抑制して、十分な機械的強度を得ることができ、リードフレームどうしが接触したりするようなことがない。

## 【0011】

【実施例】 次に本発明の実施例を図とともに説明する。図1はフィンガの一部を横断面にして示した斜視図、図2はフィンガ先端部の縦断面図、図3はフィンガの一部を示す平面図、図4は他の実施例を示すフィンガの一部を横断面にして示した斜視図、図5はリードフレームの製造工程を示す図、図6はフィンガ部のレジストパターンを示す平面図、図7はリードフレームの平面図、図8はフィンガと半導体チップの電極との接続部を示す断面図である。

【0012】 フィンガ4は金属層からなり導電性を有

し、その中央部下面にその長手方向F（図1参照）に沿って条溝4aを有し、図1に示すように半導体チップの電極と接続される上面の両側には稜線が円弧状のフランジ部4b、4cを備えている。条溝4aは図3の二点鎖線で示すように、フィンガ4の基部4d及び先端部（内端部）4eを除く中間部分に形成され、この中間部における断面形状を略々コ字状として少ない材料で曲げに対する断面二次モーメントを増大させている。

【0013】また、図2に示すようにフィンガ4の先端部4eは半導体チップ1の電極と接続される肉厚のパン

4fが形成されている。この先端部4eと中間部分を連結する部分の下面には前記条溝4aと略直交する方向に延びた凹部4gが形成され、凹部4gより先方に中間部分の上面より突出したパン

4fが形成されている。

【0014】図4はフィンガ4の他の例を示した斜視図で、前記実施例のフィンガ4の上面に更に金属薄膜4hを積層したものである。このようにすることでフィンガ4の剛性を更に増加させることができる。

【0015】図5は、このフィンガ構造のリードフレームの製造工程を示すものである。

【0016】まず（a）、（b）図に示すようにベース材として、例えばポリイミド、ポリエステル等の合成樹脂からなる厚さ35〜70μm程度のフィルム8にブツシュバック法によるプレス加工でデバイス孔9を設ける。ブツシュバック法は（a）図の如くまず押型によって所望部分を打ち抜き、次いで受型を再度上昇させて（b）図の如く切抜片10を一度穿ったデバイス孔9内に嵌合、保持させる加工方法である。従つて、加工後はフィルム8はデバイス孔9が開口されない（b）図の状態で維持され、一枚のシートとして取扱うことができる。尚、このデバイス孔9の形成時には、その他例えばスプロケット孔6（図7参照）等の窓部も同時に形成することができる。

【0017】次に開口されない前記フィルム8上には、（c）図の如く銅などの導電性金属層11が無電解メッキ、蒸着等の薄膜形成手段にて形成される。更に導電性金属層11の上には（d）図のようにフォトレジスト層12が塗布され、もしくは、厚さ150μm程度のドライフィルム状レジスト層が貼着され、フォトマスク13をかけて所望パターンに露光した後洗浄することにより感光した部分のみ取り除かれて、（e）図の如きレジスト層12が導電性金属層11上に形成される。

【0018】ブツシュバック後、この導電性金属層11やフォトレジスト層12は切抜片10の脱落を防止する仮止め手段としての機能を有するもので、フィルムのように薄状物のブツシュバックされた物のように脱着し易いものの仮り止めに特に有効である。

【0019】次にこのフィルム8上に亜セレン酸や苛性ソーダ等により剥離処理を施し、ニッケルを電鍍すると、（f）図に示すようにレジスト層12が形成されて

いない導電性金属層11の上に所望パターンのリードフレーム7が形成される。

【0020】ニッケルでリードフレーム7を電鍍する際に光沢剤が添加されるが、この光沢剤はカーボンとイオウからなり、両者の合計が0.07%以下に規制されている。そのうちカーボンの含有率が0.01〜0.04%の範囲に規制され、イオウの含有率が0.01〜0.04%の範囲に規制されている。カーボンとイオウの具体的な含有率は、前述の範囲内から適宜に選択される。

【0021】光沢剤の含有率が0.07%（すなわちカーボンの含有率が0.04%ならびにイオウの含有率が0.04%）を超えて高含有率になると、従来と同様に半導体チップとの接合時におけるリードフレーム7の温度上昇により、ニッケルが脆化して機械的強度が低下する。一方、カーボンの含有率が0.01%未満ならびにイオウの含有率が0.01%未満、すなわち光沢剤が実質的に添加されていないと、リードフレーム7の機械的強度が最初から十分でなく、加工時の変形によって隣のリードフレーム7と接触して短絡する恐れがある。

【0022】このような理由からカーボンの含有率を0.01〜0.04%の範囲に規制し、イオウの含有率を0.01〜0.04%の範囲に規制して、かつカーボンとイオウの合計含有率を0.07%以下にすることにより、半導体チップとの接合時におけるリードフレーム7の熱的影響によるニッケルの脆化を抑制して、十分な機械的強度を得ることができる。

【0023】また、イオウの含有率を0.04%以下に規制することにより、従来のようなNi-Sn合金層の発生を抑制して、半導体チップの電極とリードフレーム7との接続を確実にすることができる。

【0024】電鍍形成後にレジスト層12を除去することにより、全面にわたって導電性を有するベース材上にリードフレーム7が形成され、そのリードフレーム7のフィンガ4が前記切抜片10上に導電性金属層11を介して保持されている。

【0025】半導体チップと接合するためにデバイス孔9を閉鎖している切抜片10を抜き落せば、（g）図の如き断面のリードフレーム7が合成樹脂フィルム8上に形成される。この場合、導電性金属層11は電鍍に必要な導電性を確保するために設ける程度の厚さ例えば5〜10μm程度であり、しかも導電性金属層11のリードフレーム7が形成される表面に剥離処理が施されているから、抜き落し力は小さくて済みリードフレーム7を変形させることはない。

【0026】このようにして切抜片10を抜き落した後、半導体チップ1が搭載されて、フィンガ4と接続される。

【0027】尚、上記実施例においては、リードフレーム7はベース材としての合成樹脂フィルム8上に形成したが、このようなベース材としては導電性のステンレス

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などの金属フィルムを用いることもできる。

【0028】この場合は、(c)図に示す如き銅などからなる導電性金属層11を新たに設ける必要がなく、金属フィルムの上にフォトリソ層12を形成し、直接電鍍によつて金属フィルム上にニッケル、銅、金やそれらの合金等からなるリードフレーム7を形成することが可能である。

【0029】図6は、前記製造工程におけるフィンガ部のレジストパターンを示す図である。

【0030】フィンガ部では、所望のパターンのフィンガ用レジスト層12の他に、フィンガ4に対応する位置の非レジスト部14の中央に、その長手方向に沿ったレジスト部12aが形成され、このレジスト部12aに対応して前述の条溝4aが形成される。

【0031】また非レジスト部14の先端にはレジスト層12によつて分離された円形の非レジスト部15が形成されており、このようなレジスト層12を有する金属上に電鍍作用を施すと、電鍍開始後の初期にあつてはフィンガ4本体は、レジスト層12によつて分離された円形の非レジスト部15上に成長する金属層と別個に形成されていくが、電鍍が更に進行すると分離されていた非レジスト部15上の金属とフィンガ4本体とはレジスト層12を越えて一体に連結する。そして電鍍によつて積層される金属の厚みは電流密度によつて左右されるから、平板状のフィンガ4本体部に比べ点状の非レジスト部15上の金属層はより肉厚となり、図2に示すようなバンプ4fを形成する。

【0032】尚、図4に示すような金属薄膜4hを形成する場合には、前述の電鍍成形工程に加えて、第2次の電鍍成形を施せば良い。

【0033】またニッケルなどの金属でリードフレーム7を電鍍する際、光沢剤が含有されない層と光沢剤が含有された層の二層を重ね合わせたリードフレーム7を作ることできる。光沢剤を入れないで電鍍すると、表面が粗面化され凹凸の著しいものとなりこのため半導体チップとの接合時の温度集中、特に圧接状態で接合する際の温度集中が起こり易く、しかも硬度も低いものとなり半導体チップに大きな応力を加えずとも済み、接合を確

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実なものとすることができる。

【0034】一方、接合面と反対側に光沢剤入りの層を設ければ、リードフレーム7としての機械的強度を確保することができる。なお、光沢剤の含有率は0.07%以下に制限する必要がある。

【0035】

【発明の効果】第1の発明のように、バンプを形成するニッケル材中のイオウの含有率を0.04%以下に規制することにより、Ni-Sn合金層の生成を抑制して、半導体チップとリードフレームとの接合を確実にすることができる。

【0036】第2の発明のように、バンプを形成するニッケル材中のカーボンの含有率を0.01~0.04%の範囲に、イオウの含有率を0.01~0.04%の範囲に、かつカーボンとイオウの合計含有率を0.07%以下に規制することにより、半導体チップとの接合時におけるリードフレームの熱的影響によるニッケルの脆化を抑制して、十分な機械的強度を得ることができ、リードフレームどうしが接触したりするようなことがない。このようなことから、信頼性の高い半導体装置を提供することができる。

【図面の簡単な説明】

【図1】本発明の実施例に係るフィンガの一部を断面した斜視図である。

【図2】そのフィンガの長手方向の断面図である。

【図3】そのフィンガの一部を示す平面図である。

【図4】本発明におけるフィンガの他の実施例を示す斜視図である。

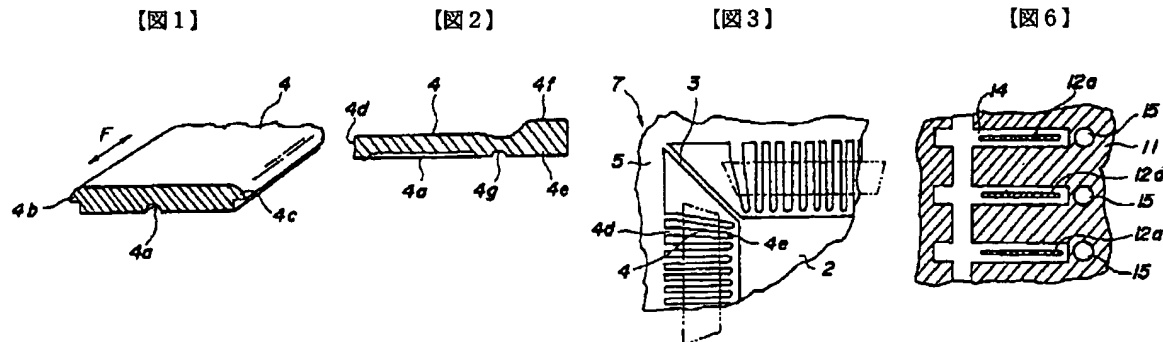
【図5】本発明の実施例に係るリードフレームの製造工程を示す図である。

【図6】フィンガ部のレジストパターンを示す図である。

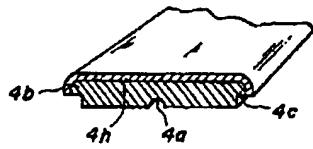
【図7】リードフレームの形状を示す平面図である。

【符号の説明】

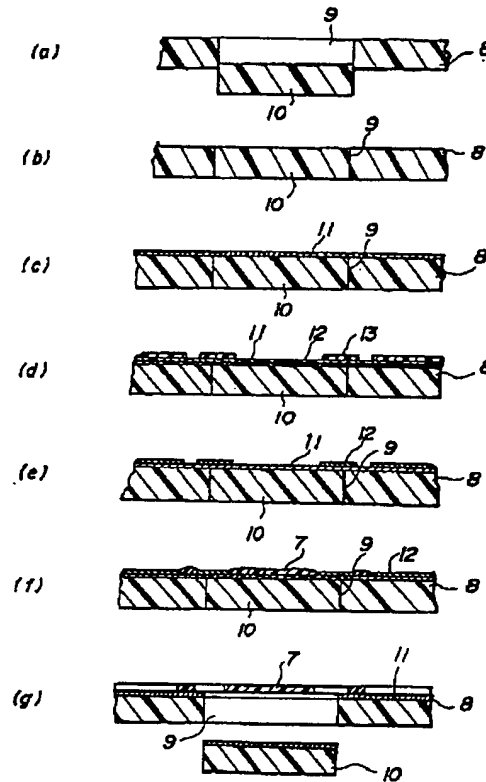
- 1 半導体チップ
- 4 フィンガ
- 7 リードフレーム



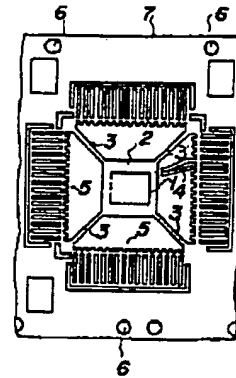
【図4】



【図5】



【図7】



フロントページの続き

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**CLAIMS**

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[Claim(s)]

[Claim 1] The semiconductor device characterized by regulating the sulfur content of the nickel material which forms said bump to 0.04% or less in the semiconductor device which comes to connect the bump of a leadframe with the electrode of a semiconductor chip.

[Claim 2] The semiconductor device characterized by for the nickel material which forms said bump being regulated by the range whose content of carbon is 0.01 - 0.04% including carbon and sulfur, and being regulated by the range whose sulphuric content is 0.01 - 0.04% in the semiconductor device which comes to connect the bump of a leadframe with the electrode of a semiconductor chip, and regulating the sum total content of carbon and sulfur to 0.07% or less.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the semiconductor device equipped with semiconductor chips, such as IC and LSI, and relates especially to the leadframe of the semiconductor device.

[0002]

[Description of the Prior Art] The metal leadframe is used for the assembly of the semiconductor device which unified the semiconductor chip by resin mold conventionally, and protruded two or more pins. The configuration of this leadframe consists of the tab lead 3 which supports the tab 2 of the rectangle which attaches a semiconductor chip 1 in those four corners, a finger 4 of a large number which make an inner edge face the periphery of a tab 2, a frame part 5 which supports these fingers 4 and the outer edge of the tab lead 3, and a sprocket hole 6 established in the both-ends edge of a frame part 5 at \*\*\*\*\* constant interval, as shown in drawing 7.

[0003] In order to have assembled the semiconductor device using such a leadframe 7, the semiconductor chip 1 was first attached on the tab 2, the inner edge (point) of the finger 4 corresponding to this was directly joined to each electrode of a semiconductor chip 1, the mold of the inside field of a frame part 5 was carried out with synthetic resin, the semiconductor chip 1 was covered, and the semiconductor device of a flat lead or an inline type had been obtained by subsequently excising a frame part 5.

[0004]

[Problem(s) to be Solved by the Invention] By the way, in the conventional semiconductor device, the problem was in the mechanical strength of a leadframe, and this invention persons found out that the content of a brightener had influenced, as a result of examining this point. That is, although carbon and sulfur are used as a brightener when forming a leadframe by nickel electroforming, the content of this brightener is usually about 0.1%. Thus, if the content of a brightener is high, at the time of the junction (soldering) to a semiconductor chip, by the temperature rise of a leadframe, nickel will stiffen and a mechanical strength will fall. Moreover, if a brightener is not contained at all, the beginning to a mechanical strength is weak and a possibility of contacting the next leadframe therefore and connecting too hastily is in the deformation at the time of processing.

[0005] Especially, when the content of the sulfur in a brightener is high, in addition to the above-mentioned problem, the nickel of a leadframe and the tin in solder react, the bad nickel-Sn alloy layer of adhesion is formed, and a leadframe may exfoliate from a semiconductor chip.

[0006] The fault of the conventional technique mentioned above is canceled, a leadframe has sufficient mechanical strength, and, moreover, the purpose of this invention has junction to the electrode of a semiconductor chip, and a leadframe in offering a positive reliable semiconductor device.

[0007]

[Means for Solving the Problem] In order to attain said purpose, the 1st this invention is characterized by regulating the sulfur content of the nickel material which forms said bump to 0.04% or less in the semiconductor device which comes to connect the bump of a leadframe with the electrode of a semiconductor chip.

[0008] In order to attain said purpose, the 2nd this invention is characterized by for the nickel material which forms said bump being regulated by the range whose content of carbon is 0.01 - 0.04% including carbon and sulfur, and being regulated by the range whose sulphuric content is 0.01 - 0.04%, and regulating the sum total content of carbon and sulfur to 0.07% or less in the semiconductor device which comes to connect the bump of a leadframe with the electrode of a semiconductor chip.



[0009]

[Function] By regulating the content of the sulfur in the nickel material which forms a bump to 0.04% or less like the 1st invention, generation of a nickel-Sn alloy layer can be controlled and junction to a semiconductor chip and a leadframe can be ensured.

[0010] the content of the carbon in the nickel material which forms a bump like the 2nd invention -- 0.01 - 0.04% of range -- sulphuric content -- 0.01 - 0.04% of range -- leadframes seem and to control embrittlement of the nickel under the thermal effect of the leadframe at the time of junction to a semiconductor chip, to be able to obtain sufficient mechanical strength, and not to contact by regulating the sum total content of carbon and sulfur to 0.07% or less

[0011]

[Example] Next, the example of this invention is explained with drawing. It is the sectional view in which the top view in which the perspective view and drawing 2 R> 2 which drawing 1 made a part of finger the cross section, and was shown show drawing of longitudinal section of a finger point, and drawing 3 shows a part of finger, the perspective view which drawing 4 made the cross section a part of finger which shows other examples, and was shown, drawing in which drawing 5 shows the production process of a leadframe, the top view in which drawing 6 shows the resist pattern of the finger section, and drawing 7 show the top view of a leadframe, and drawing 8 shows the connection of a finger and the electrode of a semiconductor chip.

[0012] The finger 4 consisted of a metal layer, and it had conductivity, and had \*\*\*\*\* 4a in the central subordinate side of that at the longitudinal direction F (refer to drawing 1 ), and the ridgeline equips with the radii-like flanges 4b and 4c the both sides of the top face connected with the electrode of a semiconductor chip as shown in drawing 1 . As the two-dot chain line of drawing 3 shows, \*\*\*\* 4a is formed in the interstitial segment except 4d of bases of a finger 4, and point (toe) 4e, and is increasing the second moment of area [ as opposed to bending for the cross-section configuration in this pars intermedia ] with few ingredients as a \*\*\*\* U shape.

[0013] Moreover, as shown in drawing 2 , thick bump 4f by which point 4e of a finger 4 is connected with the electrode of a semiconductor chip 1 is formed. 4g of crevices which extended in the direction which carries out an abbreviation rectangular cross with said \*\*\*\* 4a is formed in the inferior surface of tongue of the part which connects this point 4e and interstitial segment, and bump 4f projected from the top face of an interstitial segment to them is formed from 4g of crevices.

[0014] Drawing 4 is the perspective view having shown other examples of a finger 4, and carries out the laminating of the 4h of the metal thin films to the top face of the finger 4 of said example further. The rigidity of a finger 4 can be made to increase further by doing in this way.

[0015] Drawing 5 shows the production process of the leadframe of this finger structure.

[0016] As first shown in the (a) and (b) Fig., the device hole 9 is formed in the film 8 with a thickness of about 35-70 micrometers it is thin from synthetic resin, such as polyimide and polyester, by press working of sheet metal by the push back procedure as base material. Push back procedure is fitting and the processing approach made to hold in the \*\* device hole 9 which a request part is therefore first pierced to a force plunger, and a carrier type is subsequently raised again, and digs the piece 10 of \*\*\*\* once as shown in the (b) Fig., as shown in the (a) Fig. Therefore, the device hole 9 is maintained in the condition of the (b) Fig. by which opening is not carried out, and a film 8 can deal with after processing as a sheet of one sheet. In addition, in addition to this at the time of formation of this device hole 9, window parts, such as a sprocket hole 6 (refer to drawing 7 ), can also be formed in coincidence, for example.

[0017] Next, on said film 8 by which opening is not carried out, as shown in the (c) Fig., the conductive metal layers 11, such as copper, are formed in thin film means forming, such as electroless deposition and vacuum evaporation. Furthermore, on the conductive metal layer 11, as shown in the (d) Fig., a photoresist layer 12 is applied, or a dry film-like resist layer with a thickness of about 150 micrometers is stuck, only the part exposed by washing after exposing to a request pattern, covering a photo mask 13 is removed, and the resist layer 12 like the (e) Fig. is formed on the conductive metal layer 11.

[0018] After pushback, although this conductive metal layer 11 and photoresist layer 12 tend to drop out like the object with which it has a function as a tacking means to prevent omission of the piece 10 of \*\*\*\*, and pushback of the \*\*\*\*\* was carried out like a film, they are effective in especially a temporary stop.

[0019] Next, if exfoliation processing is performed with a selenious acid, caustic alkali of sodium, etc. on this film 8 and nickel is electroformed, the leadframe 7 of a request pattern will be formed on the conductive metal

layer 11 in which the resist layer 12 is not formed as shown in the (f) Fig.

[0020] Although a brightener is added in case a leadframe 7 is electroformed with nickel, this brightener consists of carbon and sulfur and both sum total is regulated to 0.07% or less. Among those, it is regulated by the range whose content of carbon is 0.01 - 0.04%, and is regulated by the range whose sulphuric content is 0.01 - 0.04%. The concrete content of carbon and sulfur is suitably chosen from within the limits of the above-mentioned.

[0021] If the content of a brightener turns into high content exceeding 0.07% (the content [ That is, the content of carbon ] of 0.04% and sulfur 0.04%), as usual, by the temperature rise of the leadframe 7 at the time of junction to a semiconductor chip, nickel will stiffen and a mechanical strength will fall. On the other hand, if less than 0.01%, i.e., a brightener, is not substantially added [ the content of carbon ] for the content of less than 0.01% and sulfur, the mechanical strength of a leadframe 7 is not enough from the beginning, and a possibility of contacting the next leadframe 7 therefore and connecting too hastily is in the deformation at the time of processing.

[0022] By regulating the content of carbon in 0.01 - 0.04% of range, since it is such, regulating sulphuric content in 0.01 - 0.04% of range, and making sum total content of carbon and sulfur 0.07% or less, embrittlement of the nickel under the thermal effect of the leadframe 7 at the time of junction to a semiconductor chip can be controlled, and sufficient mechanical strength can be obtained.

[0023] Moreover, by regulating sulphuric content to 0.04% or less, generating of a nickel-Sn alloy layer like before can be controlled, and connection between the electrode of a semiconductor chip and a leadframe 7 can be ensured.

[0024] By removing the resist layer 12 after electrocasting formation, a leadframe 7 is formed on the base material which has conductivity over the whole surface, and the finger 4 of the leadframe 7 is held through the conductive metal layer 11 on said piece 10 of \*\*\*\*.

[0025] If it fails to extract the piece 10 of \*\*\*\* which has closed the device hole 9 in order to join to a semiconductor chip, the leadframe 7 of the cross section like the (g) Fig. will be formed on the synthetic-resin film 8. In this case, since exfoliation processing is performed to the front face in which the leadframe 7 of the conductive metal layer 11 is moreover formed, the conductive metal layer 11 is extracted, and the dropping force is small, ends and does not make it to be the about thickness of extent prepared in order to secure conductivity required for electrocasting, for example, 5-10 micrometers, and transform a leadframe 7.

[0026] Thus, after failing to extract the piece 10 of \*\*\*\*, a semiconductor chip 1 is carried and it connects with a finger 4.

[0027] In addition, in the above-mentioned example, although the leadframe 7 was formed on the synthetic-resin film 8 as base material, it can also use metal films, such as conductive stainless steel, as such base material.

[0028] In this case, it is possible for it not to be necessary to newly form the conductive metal layer 11 which consists of \*\*\*\*\* shown in the (c) Fig., to form a photoresist layer 12 on a metal film, and to form the leadframe 7 which therefore becomes direct electrocasting from nickel, copper, gold, those alloys, etc. on a metal film.

[0029] Drawing 6 is drawing showing the resist pattern of the finger section in said production process.

[0030] In the finger section, besides the resist layer 12 for fingers of a desired pattern, \*\*\*\*\* resist section 12a is formed in that longitudinal direction, and the above-mentioned \*\*\*\* 4a is formed in the center of the non-resist section 14 of the location corresponding to a finger 4 corresponding to this resist section 12a.

[0031] Moreover, if the circular non-resist section 15 therefore divided into the resist layer 12 is formed at the tip of the non-resist section 14 and a electrocasting operation is performed on the metal which has such a resist layer 12 Although formed separately from the metal layer which grows on the circular non-resist section 15 from which \*\*\*\*\* was separated the first stage after electrocasting initiation, and finger 4 body was therefore separated into the resist layer 12 The metal on the non-resist section 15 separated when electrocasting advanced further, and finger 4 body are connected with one exceeding the resist layer 12. And since the thickness of the metal by which a laminating is therefore carried out to electrocasting is therefore influenced by current density, compared with a plate-like four finger soma, the metal layer on the punctiform non-resist section 15 becomes thicker, and it forms bump 4f as shown in drawing 2.

[0032] In addition, what is necessary is just to give the second electrocasting shaping in addition to the above-mentioned electrocasting forming cycle, in forming 4h of metal thin films as shown in drawing 4.

[0033] Moreover, in case a leadframe 7 is electroformed with metals, such as nickel, the leadframe 7 which piled up the bilayer of the layer which a brightener does not contain, and the layer which the brightener contained can also be made. If it electroforms without putting in a brightener, the temperature concentration at the time of surface roughening of the front face being carried out, it becoming what has remarkable irregularity, and joining in the state of the temperature concentration at the time of junction to a semiconductor chip, especially a pressure welding for this reason tends to take place, moreover, it will become low, and big stress is not applied to a semiconductor chip, but \*\* also ends, and a degree of hardness can also make junction a positive thing.

[0034] On the other hand, if the layer containing a brightener is prepared in a plane of composition and the opposite side, the mechanical strength as a leadframe 7 is securable. In addition, it is necessary to restrict the content of a brightener to 0.07% or less.

[0035]

[Effect of the Invention] By regulating the content of the sulfur in the nickel material which forms a bump to 0.04% or less like the 1st invention, generation of a nickel-Sn alloy layer can be controlled and junction to a semiconductor chip and a leadframe can be ensured.

[0036] the content of the carbon in the nickel material which forms a bump like the 2nd invention -- 0.01 - 0.04% of range -- sulphuric content -- 0.01 - 0.04% of range -- leadframes seem and to control embrittlement of the nickel under the thermal effect of the leadframe at the time of junction to a semiconductor chip, to be able to obtain sufficient mechanical strength, and not to contact by regulating the sum total content of carbon and sulfur to 0.07% or less Since it is such, a reliable semiconductor device can be offered.

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TECHNICAL FIELD

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[Industrial Application] This invention relates to the semiconductor device equipped with semiconductor chips, such as IC and LSI, and relates especially to the leadframe of the semiconductor device.

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PRIOR ART

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[Description of the Prior Art] The metal leadframe is used for the assembly of the semiconductor device which unified the semiconductor chip by resin mold conventionally, and protruded two or more pins. The configuration of this leadframe consists of the tab lead 3 which supports the tab 2 of the rectangle which attaches a semiconductor chip 1 in those four corners, a finger 4 of a large number which make an inner edge face the periphery of a tab 2, a frame part 5 which supports these fingers 4 and the outer edge of the tab lead 3, and a sprocket hole 6 established in the both-ends edge of a frame part 5 at \*\*\*\*\* constant interval, as shown in drawing 7.

[0003] In order to have assembled the semiconductor device using such a leadframe 7, the semiconductor chip 1 was first attached on the tab 2, the inner edge (point) of the finger 4 corresponding to this was directly joined to each electrode of a semiconductor chip 1, the mold of the inside field of a frame part 5 was carried out with synthetic resin, the semiconductor chip 1 was covered, and the semiconductor device of a flat lead or an inline type had been obtained by subsequently excising a frame part 5.

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EFFECT OF THE INVENTION

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[Effect of the Invention] By regulating the content of the sulfur in the nickel material which forms a bump to 0.04% or less like the 1st invention, generation of a nickel-Sn alloy layer can be controlled and junction to a semiconductor chip and a leadframe can be ensured.

[0036] the content of the carbon in the nickel material which forms a bump like the 2nd invention -- 0.01 - 0.04% of range -- sulphuric content -- 0.01 - 0.04% of range -- leadframes seem and to control embrittlement of the nickel under the thermal effect of the leadframe at the time of junction to a semiconductor chip, to be able to obtain sufficient mechanical strength, and not to contact by regulating the sum total content of carbon and sulfur to 0.07% or less Since it is such, a reliable semiconductor device can be offered.

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**TECHNICAL PROBLEM**

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[Problem(s) to be Solved by the Invention] By the way, in the conventional semiconductor device, the problem was in the mechanical strength of a leadframe, and this invention persons found out that the content of a brightener had influenced, as a result of examining this point. That is, although carbon and sulfur are used as a brightener when forming a leadframe by nickel electroforming, the content of this brightener is usually about 0.1%. Thus, if the content of a brightener is high, at the time of the junction (soldering) to a semiconductor chip, by the temperature rise of a leadframe, nickel will stiffen and a mechanical strength will fall. Moreover, if a brightener is not contained at all, the beginning to a mechanical strength is weak and a possibility of contacting the next leadframe therefore and connecting too hastily is in the deformation at the time of processing.

[0005] Especially, when the content of the sulfur in a brightener is high, in addition to the above-mentioned problem, the nickel of a leadframe and the tin in solder react, the bad nickel-Sn alloy layer of adhesion is formed, and a leadframe may exfoliate from a semiconductor chip.

[0006] The fault of the conventional technique mentioned above is canceled, a leadframe has sufficient mechanical strength, and, moreover, the purpose of this invention has junction to the electrode of a semiconductor chip, and a leadframe in offering a positive reliable semiconductor device.

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MEANS

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[Means for Solving the Problem] In order to attain said purpose, the 1st this invention is characterized by regulating the sulfur content of the nickel material which forms said bump to 0.04% or less in the semiconductor device which comes to connect the bump of a leadframe with the electrode of a semiconductor chip.

[0008] In order to attain said purpose, the 2nd this invention is characterized by for the nickel material which forms said bump being regulated by the range whose content of carbon is 0.01 - 0.04% including carbon and sulfur, and being regulated by the range whose sulphuric content is 0.01 - 0.04%, and regulating the sum total content of carbon and sulfur to 0.07% or less in the semiconductor device which comes to connect the bump of a leadframe with the electrode of a semiconductor chip.

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OPERATION

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[Function] By regulating the content of the sulfur in the nickel material which forms a bump to 0.04% or less like the 1st invention, generation of a nickel-Sn alloy layer can be controlled and junction to a semiconductor chip and a leadframe can be ensured.

[0010] the content of the carbon in the nickel material which forms a bump like the 2nd invention -- 0.01 - 0.04% of range -- sulphuric content -- 0.01 - 0.04% of range -- leadframes seem and to control embrittlement of the nickel under the thermal effect of the leadframe at the time of junction to a semiconductor chip, to be able to obtain sufficient mechanical strength, and not to contact by regulating the sum total content of carbon and sulfur to 0.07% or less

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EXAMPLE

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[Example] Next, the example of this invention is explained with drawing. It is the sectional view in which the top view in which the perspective view and drawing 2 R> 2 which drawing 1 made a part of finger the cross section, and was shown show drawing of longitudinal section of a finger point, and drawing 3 shows a part of finger, the perspective view which drawing 4 made the cross section a part of finger which shows other examples, and was shown, drawing in which drawing 5 shows the production process of a leadframe, the top view in which drawing 6 shows the resist pattern of the finger section, and drawing 7 show the top view of a leadframe, and drawing 8 shows the connection of a finger and the electrode of a semiconductor chip.

[0012] The finger 4 consisted of a metal layer, and it had conductivity, and had \*\*\*\*\* 4a in the central subordinate side of that at the longitudinal direction F (refer to drawing 1 ), and the ridgeline equips with the radii-like flanges 4b and 4c the both sides of the top face connected with the electrode of a semiconductor chip as shown in drawing 1 . As the two-dot chain line of drawing 3 shows, \*\*\*\* 4a is formed in the interstitial segment except 4d of bases of a finger 4, and point (toe) 4e, and is increasing the second moment of area [ as opposed to bending for the cross-section configuration in this pars intermedia ] with few ingredients as a \*\*\*\* U shape.

[0013] Moreover, as shown in drawing 2 , thick bump 4f by which point 4e of a finger 4 is connected with the electrode of a semiconductor chip 1 is formed. 4g of crevices which extended in the direction which carries out an abbreviation rectangular cross with said \*\*\*\* 4a is formed in the inferior surface of tongue of the part which connects this point 4e and interstitial segment, and bump 4f projected from the top face of an interstitial segment to them is formed from 4g of crevices.

[0014] Drawing 4 is the perspective view having shown other examples of a finger 4, and carries out the laminating of the 4h of the metal thin films to the top face of the finger 4 of said example further. The rigidity of a finger 4 can be made to increase further by doing in this way.

[0015] Drawing 5 shows the production process of the leadframe of this finger structure.

[0016] As first shown in the (a) and (b) Fig., the device hole 9 is formed in the film 8 with a thickness of about 35-70 micrometers it is thin from synthetic resin, such as polyimide and polyester, by press working of sheet metal by the push back procedure as base material. Push back procedure is fitting and the processing approach made to hold in the \*\* device hole 9 which a request part is therefore first pierced to a force plunger, and a carrier type is subsequently raised again, and digs the piece 10 of \*\*\*\* once as shown in the (b) Fig., as shown in the (a) Fig. Therefore, the device hole 9 is maintained in the condition of the (b) Fig. by which opening is not carried out, and a film 8 can deal with after processing as a sheet of one sheet. In addition, in addition to this at the time of formation of this device hole 9, window parts, such as a sprocket hole 6 (refer to drawing 7 ), can also be formed in coincidence, for example.

[0017] Next, on said film 8 by which opening is not carried out, as shown in the (c) Fig., the conductive metal layers 11, such as copper, are formed in thin film means forming, such as electroless deposition and vacuum evaporation. Furthermore, on the conductive metal layer 11, as shown in the (d) Fig., a photoresist layer 12 is applied, or a dry film-like resist layer with a thickness of about 150 micrometers is stuck, only the part exposed by washing after exposing to a request pattern, covering a photo mask 13 is removed, and the resist layer 12 like the (e) Fig. is formed on the conductive metal layer 11.

[0018] After pushback, although this conductive metal layer 11 and photoresist layer 12 tend to drop out like the object with which it has a function as a tacking means to prevent omission of the piece 10 of \*\*\*\*, and pushback of the \*\*\*\*\* was carried out like a film, they are effective in especially a temporary stop.

[0019] Next, if exfoliation processing is performed with a selenious acid, caustic alkali of sodium, etc. on this

film 8 and nickel is electroformed, the leadframe 7 of a request pattern will be formed on the conductive metal layer 11 in which the resist layer 12 is not formed as shown in the (f) Fig.

[0020] Although a brightener is added in case a leadframe 7 is electroformed with nickel, this brightener consists of carbon and sulfur and both sum total is regulated to 0.07% or less. Among those, it is regulated by the range whose content of carbon is 0.01 - 0.04%, and is regulated by the range whose sulphuric content is 0.01 - 0.04%. The concrete content of carbon and sulfur is suitably chosen from within the limits of the above-mentioned.

[0021] If the content of a brightener turns into high content exceeding 0.07% (the content [ That is, the content of carbon ] of 0.04% and sulfur 0.04%), as usual, by the temperature rise of the leadframe 7 at the time of junction to a semiconductor chip, nickel will stiffen and a mechanical strength will fall. On the other hand, if less than 0.01%, i.e., a brightener, is not substantially added [ the content of carbon ] for the content of less than 0.01% and sulfur, the mechanical strength of a leadframe 7 is not enough from the beginning, and a possibility of contacting the next leadframe 7 therefore and connecting too hastily is in the deformation at the time of processing.

[0022] By regulating the content of carbon in 0.01 - 0.04% of range, since it is such, regulating sulphuric content in 0.01 - 0.04% of range, and making sum total content of carbon and sulfur 0.07% or less, embrittlement of the nickel under the thermal effect of the leadframe 7 at the time of junction to a semiconductor chip can be controlled, and sufficient mechanical strength can be obtained.

[0023] Moreover, by regulating sulphuric content to 0.04% or less, generating of a nickel-Sn alloy layer like before can be controlled, and connection between the electrode of a semiconductor chip and a leadframe 7 can be ensured.

[0024] By removing the resist layer 12 after electrocasting formation, a leadframe 7 is formed on the base material which has conductivity over the whole surface, and the finger 4 of the leadframe 7 is held through the conductive metal layer 11 on said piece 10 of \*\*\*\*.

[0025] If it fails to extract the piece 10 of \*\*\*\* which has closed the device hole 9 in order to join to a semiconductor chip, the leadframe 7 of the cross section like the (g) Fig. will be formed on the synthetic-resin film 8. In this case, since exfoliation processing is performed to the front face in which the leadframe 7 of the conductive metal layer 11 is moreover formed, the conductive metal layer 11 is extracted, and the dropping force is small, ends and does not make it to be the about thickness of extent prepared in order to secure conductivity required for electrocasting, for example, 5-10 micrometers, and transform a leadframe 7.

[0026] Thus, after failing to extract the piece 10 of \*\*\*\*, a semiconductor chip 1 is carried and it connects with a finger 4.

[0027] In addition, in the above-mentioned example, although the leadframe 7 was formed on the synthetic-resin film 8 as base material, it can also use metal films, such as conductive stainless steel, as such base material.

[0028] In this case, it is possible for it not to be necessary to newly form the conductive metal layer 11 which consists of \*\*\*\*\* shown in the (c) Fig., to form a photoresist layer 12 on a metal film, and to form the leadframe 7 which therefore becomes direct electrocasting from nickel, copper, gold, those alloys, etc. on a metal film.

[0029] Drawing 6 is drawing showing the resist pattern of the finger section in said production process.

[0030] In the finger section, besides the resist layer 12 for fingers of a desired pattern, \*\*\*\*\* resist section 12a is formed in that longitudinal direction, and the above-mentioned \*\*\*\* 4a is formed in the center of the non-resist section 14 of the location corresponding to a finger 4 corresponding to this resist section 12a.

[0031] Moreover, if the circular non-resist section 15 therefore divided into the resist layer 12 is formed at the tip of the non-resist section 14 and a electrocasting operation is performed on the metal which has such a resist layer 12 Although formed separately from the metal layer which grows on the circular non-resist section 15 from which \*\*\*\*\* was separated the first stage after electrocasting initiation, and finger 4 body was therefore separated into the resist layer 12 The metal on the non-resist section 15 separated when electrocasting advanced further, and finger 4 body are connected with one exceeding the resist layer 12. And since the thickness of the metal by which a laminating is therefore carried out to electrocasting is therefore influenced by current density, compared with a plate-like four finger soma, the metal layer on the punctiform non-resist section 15 becomes thicker, and it forms bump 4f as shown in drawing 2.

[0032] In addition, what is necessary is just to give the second electrocasting shaping in addition to the above-

mentioned electrocasting forming cycle, in forming 4h of metal thin films as shown in drawing 4.

[0033] Moreover, in case a leadframe 7 is electroformed with metals, such as nickel, the leadframe 7 which piled up the bilayer of the layer which a brightener does not contain, and the layer which the brightener contained can also be made. If it electroforms without putting in a brightener, the temperature concentration at the time of surface roughening of the front face being carried out, it becoming what has remarkable irregularity, and joining in the state of the temperature concentration at the time of junction to a semiconductor chip, especially a pressure welding for this reason tends to take place, moreover, it will become low, and big stress is not applied to a semiconductor chip, but \*\* also ends, and a degree of hardness can also make junction a positive thing.

[0034] On the other hand, if the layer containing a brightener is prepared in a plane of composition and the opposite side, the mechanical strength as a leadframe 7 is securable. In addition, it is necessary to restrict the content of a brightener to 0.07% or less.

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[Translation done.]

\* NOTICES \*

JPO and NCIPi are not responsible for any damages caused by the use of this translation.

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the perspective view which carried out the cross section of a part of finger concerning the example of this invention.

[Drawing 2] It is the sectional view of the longitudinal direction of the finger.

[Drawing 3] It is the top view showing a part of the finger.

[Drawing 4] It is the perspective view showing other examples of the finger in this invention.

[Drawing 5] It is drawing showing the production process of the leadframe concerning the example of this invention.

[Drawing 6] It is drawing showing the resist pattern of the finger section.

[Drawing 7] It is the top view showing the configuration of a leadframe.

[Description of Notations]

1 Semiconductor Chip

4 Finger

7 Leadframe

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[Translation done.]

\* NOTICES \*

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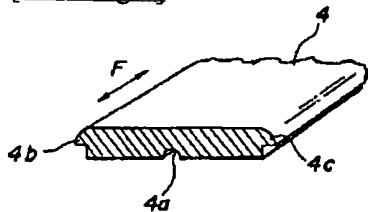
1. This document has been translated by computer. So the translation may not reflect the original precisely.
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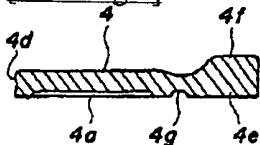
DRAWINGS

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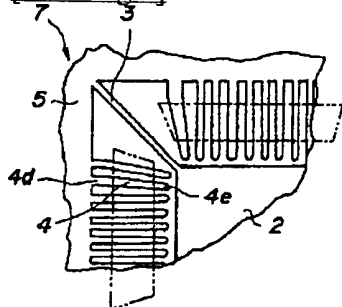
[Drawing 1]



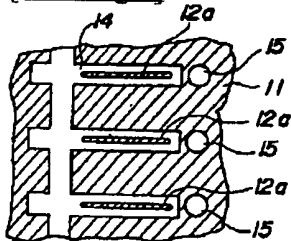
[Drawing 2]



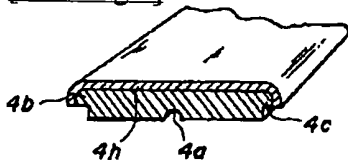
[Drawing 3]



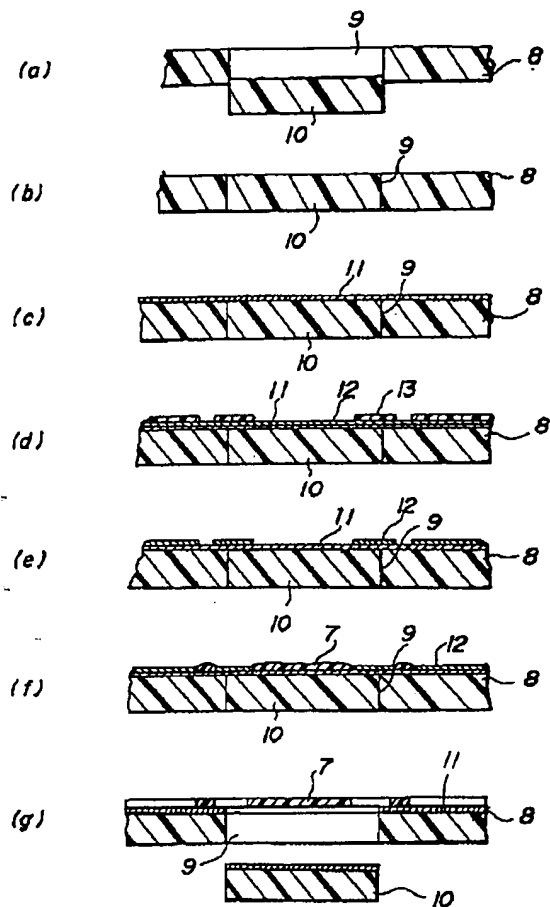
[Drawing 6]



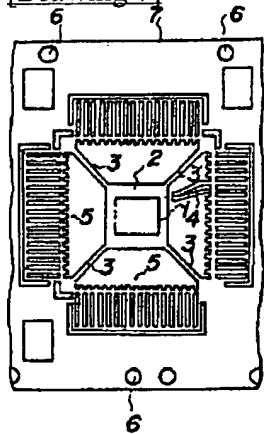
[Drawing 4]



[Drawing 5]



[Drawing 7]



[Translation done.]

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